Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Chem 313, Chapter 2

**Matter is Made of Atoms**

*Chapter Outline*

**2.1 Atoms and Their Structures**

*Vocabulary*

|  |  |  |
| --- | --- | --- |
| Atom | atomic theory | law of conservation of mass |
| Mass number | Electron | Proton |
| Isotope | Neutron | Nucleus |
| Atomic number |  |  |

*Objectives*

* **Relate** historic experiments to the development of the modern model of the atom
* **Illustrate** the modern model of the atom
* **Interpret** the information available in an element block of the periodic table
* **Calculate** atomic mass from isotopic data

**2.2 Electron in Atoms**

*Vocabulary*

|  |  |  |
| --- | --- | --- |
| Emission Spectrum | Energy level | Electromagnetic spectrum |
| Electron cloud | Valence electron | Lewis dot diagram |
| Atomic orbital | Electron configuration | Electromagnetic radiation |
| Wavelength | Frequency | Amplitude |
| quantum |  |  |

*Objectives*

* **Relate** the electron to modern atomic theory
* **Write** electron configurations using electron configuration notation
* **Illustrate** valence electrons using Lewis dot structures
* **Describe** waves in terms of wavelength, frequency, and energy
* **Define** a quantum of energy and **explain** how it is related to an energy changes in the atom

|  |  |
| --- | --- |
| **Term** | **Definition** |
| Atom |  |
| Atomic Theory |  |
| Law of Conservation of Mass |  |
| Mass number |  |
| Electron |  |
| Proton |  |
| Isotope |  |
| Neutron |  |
| Nucleus |  |
| Atomic number |  |
| Emission Spectrum |  |
| Energy Level |  |
| Electromagnetic Spectrum |  |
| Electron cloud |  |
| Valence Electron |  |
| Lewis Dot Diagram |  |
| Atomic orbital |  |
| Electron Configuration |  |
| Electromagnetic Radiation |  |
| Wavelength |  |
| Frequency |  |
| Amplitude |  |
| Quantum |  |

**Warm-up #1:** What is the difference between a theory and a law?

**Slide 3: Atomic Theory**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

(460-370 BC)

Atoms are the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ particles of matter and different types of atoms exist for every type of matter.

* + The idea that matter is made up of fundamental particles called atoms is known as the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of matter.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

(about 2,500 years ago)

**Slide 4: Atomic Theory**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

(1799)

The elements that compose a compound are always in a certain proportion by mass.

* + This principle is now referred to as the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

(1782)

When a chemical reaction occurs, matter is neither created nor destroyed but only changed.

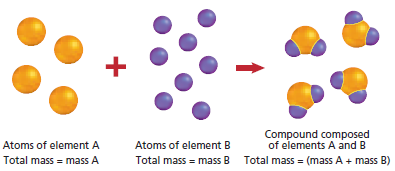
* + This became known as the
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Slide 5: Dalton’s Atomic Theory**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( )

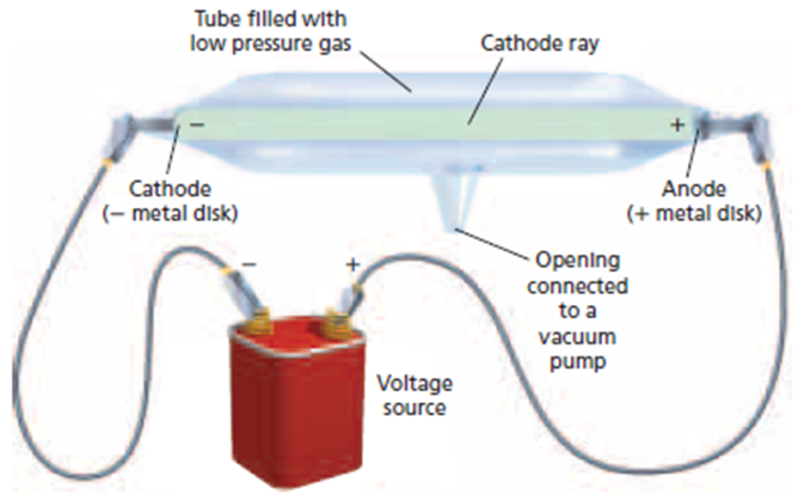
1. All matter is composed of extremely small particles called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. All atoms of a given element are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ having the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_properties. Atoms of a specific element are different from those of any other element.
3. Atoms cannot be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ into smaller particles or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
4. Different atoms combine in simple \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ratios to form compounds.
5. In a chemical reaction atoms are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Slide 6: Dalton’s Atomic Theory**

****

Mass of compound AB =

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



**Slide 7: Discovery of the Electron**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (1897)

* + Discovered that Dalton’s solid ball model was not accurate.

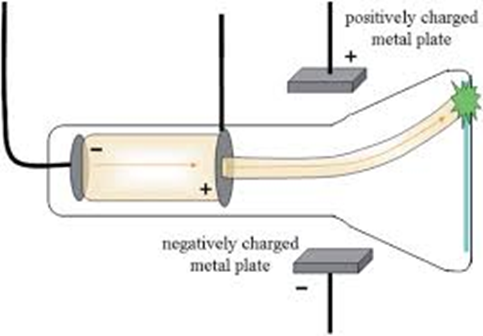
**Slide 8: The Cathode Ray Experiment**

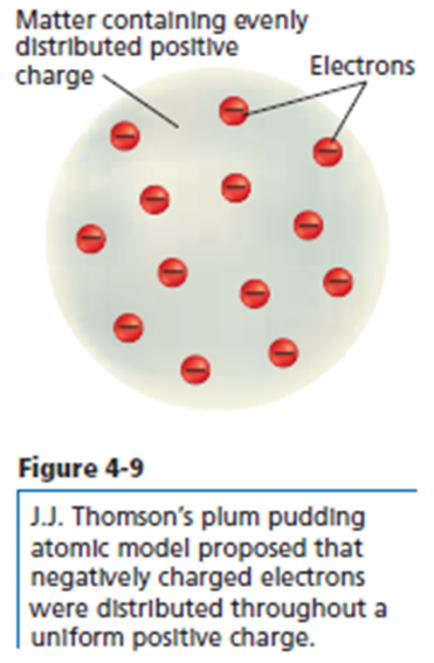
Conclusion…

The rays bent \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_a positively charged plate and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ from a negatively charged plate.

* + - * Objects with \_\_\_\_\_\_\_\_\_\_\_charges \_\_\_\_\_\_\_\_\_\_\_\_ each other, and objects with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_charges \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ each other.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_rays are made up of invisible, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_charged particles referred to as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.





**Slide 9: Thomson’s Plum Pudding Model**

­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_(1910)

The “Plum Pudding” Model

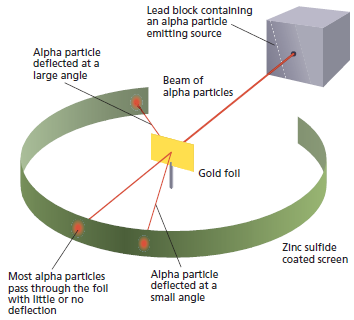
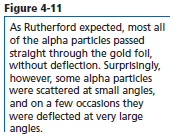
**Exit Question #1:** If an electrical field was applied to the cathode ray tube below. Which direction (up or down) would the beam of light be bent? Explain

**Warm-up Questions #2:** Why is the path of the red ball to the right when it gets hit by the white cue ball?

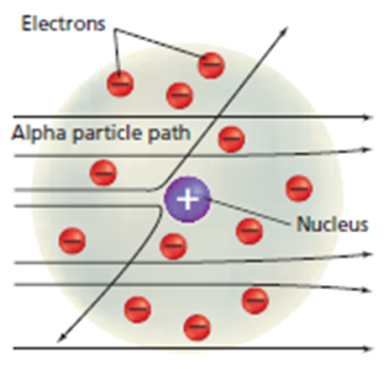
**Slide 13: The Gold Foil Experiment**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (1909)

* + Revealed that Thomson’s plum pudding model was not accurate.



**Slide 14: Discovery of the Nucleus**

Conclusion…

Because most of the particles passed through the foil, they concluded that the atom is nearly all \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Because a few particles were deflected, they proposed that the atom has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_charged central core, called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Slide 15: Rutherford’s Nuclear Model**

Rutherford’s Nuclear Model

- Consisting of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

- Protons and Neutrons hadn’t been discovered yet.

**Slide 16: Further Atomic Developments**

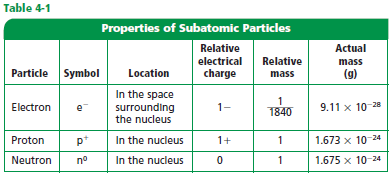
* + Scientists also determined that the rays in the cathode ray tube were also composed of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged subatomic particles called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Atoms of an element that are chemically alike but differ in mass are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an element.
  + The existence of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_particle, called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, was confirmed in the early 1930s.

**Exit Question #2:** What keeps the electrons from leaving the atom?

**Bonus:** What keeps the electrons in motion away from the nucleus?

**Warm-up Questions #3:** Examine the picture below. What percentage of all the fruit pictured is bananas?

**Slide 19: Atomic Particles**



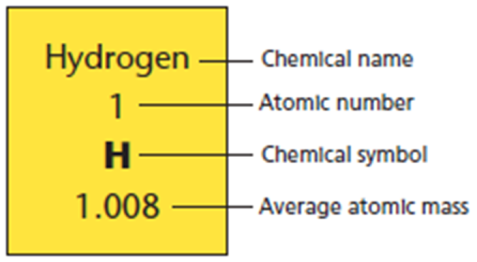
**Slide 20: Atomic Particles**

* The atomic number of an element is the number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the nucleus of an atom of that element.
  + It is the number of protons that determines the identity of an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, as well as many of its chemical and physical \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Atomic number = number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

* The \_\_\_\_\_\_\_\_\_\_\_\_ of the protons and neutrons in the nucleus is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of that particular atom.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an element have different mass numbers because they have different numbers of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, but they all have the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ number.

**Mass number = number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ + number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Slide 21: Atomic Particles**

The number at the bottom of each box is the average atomic \_\_\_\_\_\_\_\_\_\_\_\_\_ of that element.

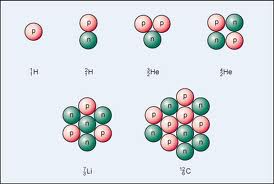
This number is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_mass of all the naturally occurring \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of that element.

**Slide 22: Atomic Mass Problems**

What is average atomic mass of Lithium if 7.42% exists as Li-6 (6.015g)and 92.58% exists as Li-7 (7.016 g)?

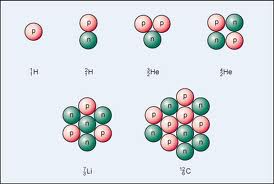
The atomic mass of neon 20.18 amu. Isotope X has a mass of 20.000 amu and isotope Y has a mass of 22.189 amu. Which isotope is more abundant, X or Y? Explain

**Exit Question #3:** What are the similarities and differences between these 3 diagrams?

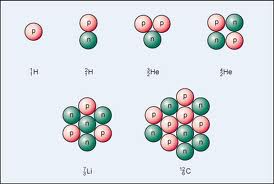


e

e



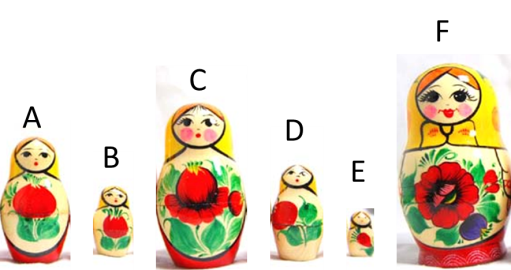
e

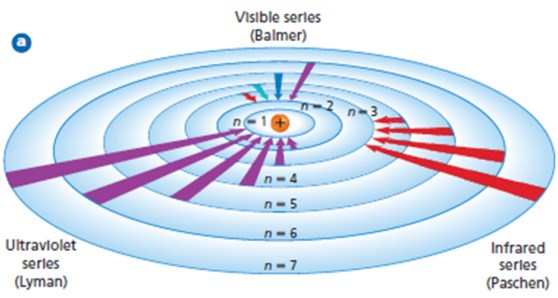


e

e

**Warm-up Questions #4:** Order these nesting dolls from the inside out



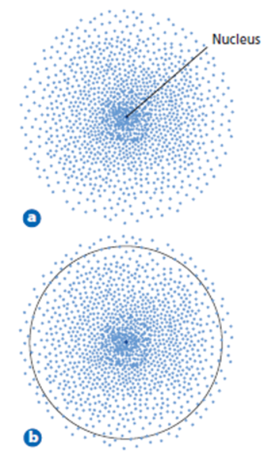


**Slide 26: Bohr’s Planetary Model**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (1913)

* + He proposed that atoms have only certain allowable \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_states
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ state
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_state
  + Electrons move around the nucleus in only certain allowed circular \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Slide 27: The Electron Cloud Model**

* Bohr’s planetary model was found to be inaccurate.
  + The electron cloud model shows that electrons are most likely to be found in certain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of space around the nucleus.
    - The space around the nucleus of an atom where the atom’s electrons are found is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Slide 28: Electron Configuration**

* A three-dimensional region around the nucleus called an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ describes the electron’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_location.

**Slide 29: Electron Configuration**

The arrangement of electrons in an atom is called the atom’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_energy level (1, 2, 3, 4, etc…)
  2. Energy sublevel (\_\_\_, \_\_\_, \_\_\_\_ and \_\_\_)
  3. Atomic \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  4. The number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in those orbitals

|  |  |  |  |
| --- | --- | --- | --- |
| **Energy Level** | **Sublevel** | **Atomic Orbitals** | **Number of Electrons** |
| 1 | s | 1 | 2 |
| 2 | s, p | 1, 3 | 2, 6 |
| 3 | s, p, d | 1, 3, 5 | 2, 6, 10 |
| 4 | s, p, d, f | 1, 3, 5, 7 | 2, 6, 10, 14 |

**Slide 30: Electron Configuration**

Aufbau Diagram

**Example**

Write the electron configuration for neon.

Number of electrons? \_\_\_\_

Electron Configuration?



**Slide 31: Valence Electrons**

* The electrons in the outermost energy level are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons.
  + When atoms come near each other, it is these electrons that interact with one another.
  + Many of the chemical and physical properties of an element are directly related to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of valence electrons.

**Slide 32: Lewis Dot Structures**

* A Lewis dot diagram illustrates valence electrons as \_\_\_\_\_\_\_\_\_\_ around the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the element.
  + Each dot represents \_\_\_\_\_\_\_\_ valence electron, and the element’s symbol represents the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the atom (the nucleus plus all the inner electrons).

**Slide 33: Electron Configuration and Lewis Dot Structures**

Example: Write the electron configuration and Lewis dot diagram for an atom of boron.

ELECTRONS \_\_\_\_\_

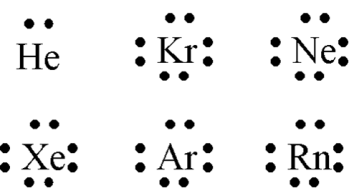
ELECTRON CONFIGURATION \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

VALENCE ELECTRONS \_\_\_\_\_

SYMBOL \_\_\_\_\_

LEWIS DOT DIAGRAM

**Exit Questions #4:** Why does the Lewis dot diagram for helium look different than the diagrams for the other noble gases?

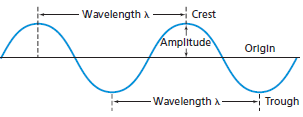
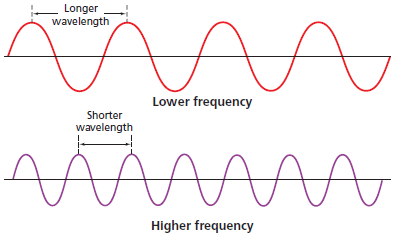


**Warm-up Question #5:** How are the bright lights in the signs generated?

**Slide 37: Electromagnetic Spectrum**

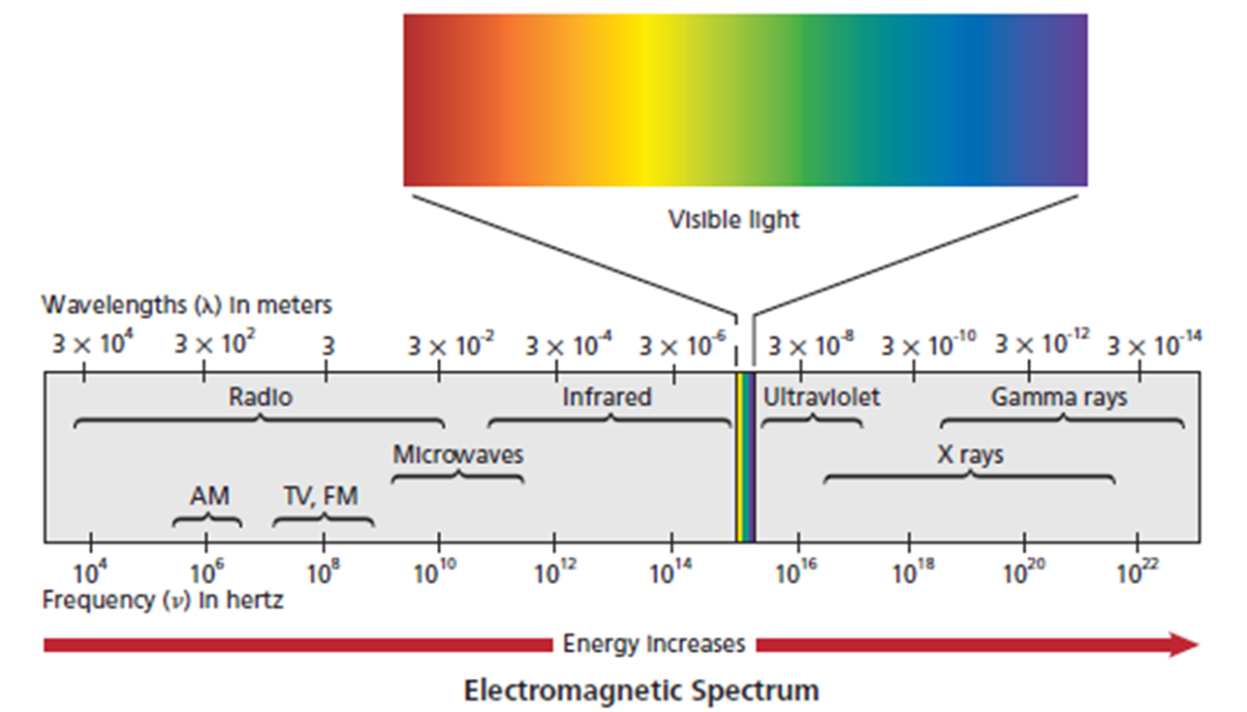
* Electromagnetic radiation is a form of \_\_\_\_\_\_\_\_\_\_\_\_\_\_that exhibits \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ behavior as it travels through space.
  + All of the forms of radiant energy are parts of a whole range of electromagnetic \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_called the electromagnetic spectrum.
    - All waves can be described by several characteristics…
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (λ) is the shortest distance between equivalent points on a continuous wave (m, cm, or nm).
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(ν) is the number of waves that pass a given point per second (1/s, s-1, or Hz).
      * Amplitude is the wave’s height from the origin to a crest (or to a trough).
      * All waves travel at the speed of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (3.00x108 m/s).

**Slide 38: Light Waves**





**Slide 39: Electromagnetic Spectrum**



**Slide 40: Wave Problem**

Example: What is the wavelength of a microwave having a frequency of 3.44x109 Hz?

KNOWNS & UNKNOWNS \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

FORMULA \_\_\_\_\_\_\_\_\_\_

REARRANGED FORMULA \_\_\_\_\_\_\_\_\_\_

PLUG-IN NUMBERS \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ANSWER (with unit) \_\_\_\_\_\_\_\_\_\_

**Slide 41: Quanta**

* Matter can \_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_ energy in only small, specific amounts called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + A quantum is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ amount of energy that can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_ by an atom.
    - \_\_\_\_\_ = energy in Joules (J)
    - \_\_\_\_\_ = Planck’s constant = 6.626x10-34 (J.s)
    - \_\_\_\_\_= frequency in Hertz (Hz)

**Slide 42: Wave Problem**

* Example…

Tiny water drops in the air disperse the white light of the sun into a rainbow. What is the energy of a photon from the violet portion of the rainbow if it has a frequency of 7.23x1014 Hz?

KNOWNS & UNKNOWNS \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

FORMULA \_\_\_\_\_\_\_\_\_\_

REARRANGED FORMULA \_\_\_\_\_\_\_\_\_\_

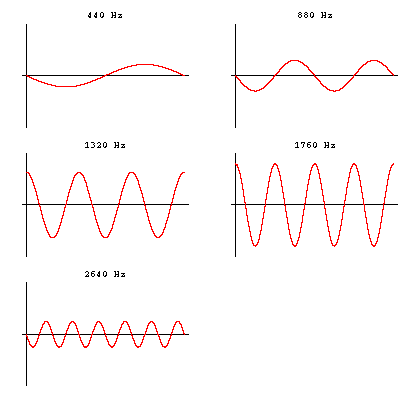
PLUG-IN NUMBERS \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ANSWER (with unit) \_\_\_\_\_\_\_\_\_\_

**Slide 43: Electromagnetic Spectrum**

* The atomic emission spectrum of an element is the set of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the electromagnetic \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_emitted by atoms of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Exit Question #5:** Which wave has the….



A

C

B

E

D

Longest wavelength?

Highest frequency?

Lowest E

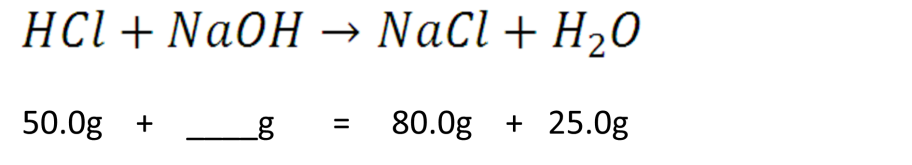
Highest Frequency?

Lowest Energy?

NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Homework Assignment #1**

1. Define the following vocabulary terms in the vocab section of the packet:  *atom, atomic theory, law of conservation of mass.*
2. What is the similarity between Democritus’ ideas about the atom with that of Dalton?
3. What are the major points in Dalton’s atomic theory?
4. Which parts of Dalton’s atomic theory are no longer valid. Explain.
5. What was Lavoisier’s contribution to the development of the modern atomic theory?
6. According to the Law of Conservation of Mass, what mass of NaOH would have been used in the following chemical reaction?



1. How is Dalton’s model of the atom different from Thomson’s Model?

**Homework Assignment #2** *Due: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

1. Define the following vocabulary terms in the vocab section of the packet: *electron, proton, neutron, nucleus, atomic number, atomic mass, and isotope.*
2. How is Rutherford’s model of the atom different from that of Thomson?
3. Why did Rutherford conclude that an atom’s nucleus has a positive charge instead of a negative charge? Summarize the conclusions that Rutherford’s team made about the structure of an atom.
4. The isotope of carbon that is used to date prehistoric fossils contains six protons and eight neutrons. What is the atomic number of this isotope? How many electrons does it have? What is its mass number?
5. Fill in the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Element | Symbol | # of Protons | # of Electrons | # of Neutrons | Mass Number |
| Magnesium |  |  |  | 12 |  |
| Polonium |  |  | 84 |  | 125 |
|  | Fe |  |  | 30 |  |

1. The element copper has naturally occurring isotopes with mass numbers of 63 and 65.

The relative abundance and atomic masses are 69.2% for a mass of 62.93amu and 30.8% for a mass of 64.93amu. Calculate the average atomic mass of copper.

1. There are three isotopes of silicon. They have mass numbers of 28, 29 and 30. The average atomic mass of silicon is 28.086amu. What does this say about the relative abundances of the three isotopes?

**Homework Assignment #3** *Due: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

1. Define the following vocabulary terms in the vocab section of the packet: *electron cloud, energy level, atomic orbital, electron configuration, valence electron, Lewis dot diagram*.
2. Write the electron configurations for the following elements.
3. bromine
4. strontium
5. antimony
6. titanium
7. Write the Lewis dot diagrams for the elements listed in #1.
8. How many electrons occupy p orbitals in a chlorine atom?

**Homework Assignment #4** *Due: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

1. Define the following vocabulary terms in the vocab section of the packet: *electromagnetic radiation, wavelength, frequency, amplitude, and quantum.*
2. What is the frequency of green light, which has a wavelength of 4.90x10-7 m?
3. What is the speed of an electromagnetic wave that has a frequency of 7.8x106 Hz?
4. What is the energy of radiation with a frequency of 9.50x1013 Hz?

1. Describe the relationship among frequency, wavelength, and energy of electromagnetic waves.
2. Which wave has greater amount of energy a microwave or a radiowave?